REMARKS

The present claims relate to a method of forming a weld between plastics workpieces over a joint region.

Amendment summary

Upon entry of this Amendment, Claims 2-8, 10, 13-21, 26-27, 29-30, and 62-75 will be pending.

The claims have been amended to remove the recitation that the dye is organic.

In addition, Claim 10 has been amended to recite that the dye "is dissolved in use." Support for this amendment is found, e.g., on page 3, line 16 of the original specification.

No new matter has been added by this Amendment, and Applicant respectfully submits that entry of this Amendment is proper.

Status of the claims

The specification has been objected to for the introduction of allegedly new matter. Claims 2-8, 10, 13-21, 26, 27, 29, 30, and 62-75 were rejected under 35 U.S.C. § 112 as allegedly failing to comply with the written description requirement. Claims 2-8, 10, 13-21, 26-27, 29, 62, and 68-74 were rejected under 35 U.S.C. § 103 as allegedly being unpatentable over Corrsin (U.S. Patent No. 3,477,194) in view of Andrus et al. (U.S. Patent No. 5,093,147)

(hereinafter "Andrus"). In addition, Claims 2-8, 10, 13-21, 27, 29, 62, and 67-75 were rejected under 35 U.S.C. § 103 as allegedly being unpatentable over Muellich (U.S. Patent No. 5,893,959) in view of Andrus. Further, Claims to 63-67 were rejected under 35 U.S.C. § 103 as allegedly being unpatentable over Corrsin and Andrus in view of Osborne (U.S. Patent No. 4,069,080). Finally, Claims 26, 30, and 63-66 were rejected under 35 U.S.C. § 103 as allegedly being unpatentable over Muellich and Andrus in view of Osborne.

Response to objection to the specification and rejection of Claims 2-8, 10, 13-21, 26, 27, 29, 30, and 62-75 under 35 U.S.C. § 112

The specification was objected to and the claims above were rejected due to the inclusion of the phrase "organic dye." Applicant respectfully notes that the phrase "organic dye" does not appear in the present claims, and Applicant respectfully submits that the rejection and objection has been rendered moot. Accordingly, Applicant respectfully requests that the objection and the § 112 rejection be withdrawn.

Request for the Examiner to consider the Declaration

On page 6 of the Office Action, the Examiner indicated that the Declaration submitted with Applicant's previous Amendment had not been considered, but would be considered once the new matter issues were resolved. Applicant respectfully submits that, as discussed above,

any new matter issues have been resolved, and respectfully requests that the Examiner properly consider the Declaration.

Response to rejection of Claims 2-8, 10, 13-21, 26-27, 29, 62, and 68-74 under 35 U.S.C. § 103 based on Corrsin in view of Andrus

Applicant respectfully traverses this rejection and submits that the combination of features defined by these claims would not have been rendered *prima facie* obvious in view of Corrsin and Andrus, as evidenced by the following.

The present claims recite a method of forming a weld between plastics workpieces over a joint region, the method comprising exposing the joint region to incident radiation having a wavelength outside the visible range so as to cause melting of the surface of one or both workpieces at the joint region, and allowing the melted material to cool thereby welding the workpieces together. The method further comprises providing a radiation absorbing dye at the joint region in one of the workpieces or between the workpieces which has an absorption band in the range 780 nm – 1500 nm matched to the wavelength of the incident radiation so as to absorb the incident radiation and generate heat for the melting process wherein the radiation absorbing dye is dissolved in use and is visually transmissive after welding.

As discussed in the Declaration, specifically on page 6, the recitation that the radiation absorbing dye is dissolved in use relates to the structure of the radiation absorbing dye. Page 6 of the Declaration includes the first part of Table 1, which compares the properties of organic and inorganic radiation absorbers. As can be seen from row 3 of the Table, the listed inorganic

absorbers are not dissolved in a polymer host. Therefore, the recitation in the present claims that the radiation absorbing dye is "dissolved in use" refers to the fact that the radiation absorbing dye is not inorganic.

Applicant respectfully traverses this rejection for the following reasons. Notably, Applicant respectfully disagrees with the Examiner's characterization of Corrsin's disclosure, as set forth in the Office Action. For instance, in rejecting claim 10, the Examiner alleges as follows:

> Corrsin discloses the sealing of thermoplastic thin materials using infrared radiation and a ***carbon material*** in between the materials. The ***carbon substance*** is printed onto a board, which is faced or overlaid with a thermoplastic material. The coating and film are welded throughout the area overlying the infrared absorbing material. ***Absorbers may also be in the form of inks*** (functional equivalent of a dye). Lamps or carbon dioxide lasers can be used. An absorber can be a visually transparent radiation absorber that is selective to radiation in a certain range of wavelengths. Specifically two transparent films or substantially transparent films are sealed together by employing a substantially visually transparent radiation absorber which selectively absorbs radiation in a wavelength range to which the films are transparent, thus causing a concentration of heat in areas where such absorber has been applied and thereby effecting sealing. (abstract, figures, col. 1, lines 20-50, col. 2, lines 24-57, col. 3, lines 30-71, col. 4, lines 5).

See Office Action at page 3 (emphasis added).

As discussed in greater detail under the subsections set forth below, Applicant submits that Corrsin cannot reasonably be interpreted so as to teach certain features of the method defined by claim 10. For instance, Corrsin discloses carbon, polybutadiene, and gypsum as radiation absorbing materials, none of which can be considered consistent with a radiation absorbing material having an absorption band in the range recited and exhibiting the properties of being visually transmissive after welding and dissolved in use, as claimed.

a. Corrsin's teaching of Carbon as a radiation absorber does not suggest a radiation absorber as claimed.

The disclosure of Corrsin is largely focused on the use of carbon as a radiation absorber. *See* Amendment Under 37 C.F.R. § 1.114 filed July 24, 2006 (hereinafter "Amendment") at page 11; *see also* Corrsin at col. 1, lines 40-51 and col. 2, lines 32-43. Thus, as previously discussed, since carbon is opaque, the carbon cannot reasonably be considered to be "visually transmissive", as claimed. Rather, carbon, which is a pigment, is a black particulate. *See* Decl. at page 6.

As further discussed in the 132 Declaration, carbon has a relatively featureless absorbance spectrum. *See* Decl. at page 10. This featureless profile of carbon stands in contrast to a radiation absorber *matched* to a wavelength of incident radiation, such as those depicted in Figs. 3(a)-(b). *See* Decl. at pages 8-9. Moreover, the "inks" that the Examiner refers to in the

grounds of rejection are disclosed by Corrsin as "carbon containing inks", which would likewise opaque and would therefore not disclose a radiation absorbing material, as claimed.

b. Corrsin's teaching of gypsum likewise does not disclose a radiation absorber that is visually transmissive in the manner defined by claim 10.

The only disclosure of a radiation absorbing material in Corrsin that is exposed to incident radiation falling within the range of 780-1500 nm is gypsum. However, gypsum cannot correspond to the radiation absorbing material employed in the method defined by claim 10. As discussed in the 132 Declaration, Corrsin's teaching of gypsum as a radiation absorber is demonstrated experimentally, and the deficiencies of gypsum are set forth. *See* Decl. at pages 16-21.

For instance, Corrsin discloses a "selective absorber" as being prepared from gypsum ($CaSO_4 \cdot 2H_20$) mixed with water and calcium oleate as a dispersant. *See* Corrsin at col. 4, lines 23-31. Corrsin further teaches that polyethylene film is coated with the radiation absorber, which will "selectively absorb radiation in the near infrared from 1 to 3 microns". Further, the radiation source is taught as being "an incandescent source such as a tungsten filament." *See* Corrsin at 4, lines 21-22.

However, when replicating Corrsin's teaching of gypsum, as set forth in the 132 Declaration, a successful weld was achieved *only* in the case of a clear film to a black carbon pigmented polyethylene film, which no gypsum coating was applied. *See* Decl. at pages 16-21.

In the remaining cases in which gypsum coating was applied between films (i.e., clear to black carbon pigmented polyethylene film, and clear to clear polyethylene film), no welding was achieved, and the gypsum coating gave a visible white appearance to the polyethylene film before and after irradiation by the lamp. *See* Decl. at page 20. Moreover, when gypsum was placed between clear-to-clear film samples and exposed to incident radiation of 940 nm from a diode laser source, again no welding was demonstrated. *See* Decl. at pages 21.

Thus, as discussed in the Declaration, one can reasonably conclude that gypsum does not assist welding of a *visually transmissive* thermoplastic film to either a pigmented or visually transmissive film. Rather, as experimentally demonstrated, gypsum acted as a barrier to welding considering such that the transmissive and pigmented films could be welded *without* the gypsum coating, but could not be welded when gypsum coating is applied. *See* Decl. at page 21.

Additionally, the gypsum coating applied per Corrsin's teaching was clearly visible on either a clear uncolored film or a black pigmented film both before and after irradiation by an infrared heat source. This coloration is inconsistent with the feature of claim 10 defining a *visually transmissive* radiation absorber that is visually transmissive after welding. *See* Decl. at page 21.

Moreover, where Corrsin does disclose an incident radiation of 1000 nm to 3000 nm, which would partially overly the claimed range, the radiation absorber is not visually transmissive, and therefore does not suggest a radiation absorbing dye, as recited by claim 10.

c. Polybutadiene does not absorb within the claimed range

As discussed in the 132 Declaration, polybutadiene and its copolymers are described by Corrsin as being selective absorbers at a wavelength of *10.6 microns*, or 10,600 nm. *See* Decl. at pages 11-13. However, at the range of 780-1500 nm, which is recited by claim 10, the copolymer of polybutadiene does not exhibit any significant absorption characteristics. *See* Decl. at page 12 and Fig. 6(a).

Further, Fig. 6(b) of the 132 Declaration provides a broader depiction of the absorbance spectrum of polybutadiene itself, which clearly depicts peak absorption occurring between 10,000 nm and 11,000 nm. *See* Decl. at page 13 and Fig. 6(b). Such absorption characteristics are consistent with Corrsin's teaching of using polybutadiene as a radiation absorber in connection with exposure to an incident radiation having a wavelength range well beyond the claimed range of 780-1500 nm.

Also, polybutadiene is a rubber polymer, and polybutadiene with styrene acrylonitrile is ABS, a thermoplastic. Almost all polymers exhibit intrinsic absorption in the wavelength range of 10.6 microns, the extent of which depends on the particular polymer. As a result, polymers can be welded together in the wavelength range of 10.6 microns without an absorber as a result of their intrinsic absorption.

Thus, Corrsin teaches the use of a rubber polymer (polybutadiene) to join two other polymer (polyethylene) sheets together. Moreover, sheets of polyethylene can be joined to each other without the need of any radiation absorbing material due to the intrinsic absorption

properties in the 10.6 micron wavelength, as discussed, for example in Osborne at col. 1, lines 15-64.[2]

In other words, Corrsin's teaching of the use of polybutadiene as a visually transmissive absorber relies on the intrinsic absorption of polymers to affect a seal at the 10.6 micron wavelength. Polybutadiene does not, however, absorb at 780-1500 nm, as claimed. Consequently, the "visually transmissive" absorbers disclosed by Corrsin do not suggest a radiation absorbing dye provided at the joint region that has an absorption band in the range 780-1500 nm matched to the wavelength of incident radiation.

d. Summary of the deficiencies of Corrsin

Initially, Applicant notes that the use as carbon as a radiation absorber is not visually transmissive and therefore does not suggest a radiation absorbing dye, as recited by claim 10, that is visually transmissive after welding and is dissolved in use. Indeed, carbon is both inorganic and opaque and the use of carbon as a radiation absorber would therefore teach one of ordinary skill away from the claimed method.

Second, although Corrsin may generally refer to welding of plastic films by the use of infrared radiation, Corrsin does not disclose the use of a ***visually transmissive*** radiation absorber having an absorption band in the claimed range of ***780-1500 nm*** that is also matched to the

[2] Osborne is relied upon by the Examiner in the rejections of claims 63-67.

wavelength of incident radiation. Rather, as noted above, Corrsin teaches the use of polybutadiene alone or with copolymers at an incident radiation of 10,600 nm, lying well beyond the recited range.

Third, the only specific mention of a radiation absorber that is exposed to incident radiation falling within the claimed range of 780-1500 nm is gypsum, which is a solid white pigment and therefore not visually transmissive. Thus, where Corrsin does disclose an incident radiation 1000 nm to 3000 nm, the radiation absorber is not visually transmissive, and therefore does not suggest a radiation absorbing dye, as recited by claim 10, that is visually transmissive after welding.

As evidenced by the foregoing, Applicant submits that Corrsin is deficient at least with respect to the features of providing a radiation absorbing dye at the joint region in one of the workpieces or between the workpieces which has an absorption band in the range 780 nm – 1500 nm matched to the wavelength of the incident radiation so as to absorb the incident radiation and generate heat for the melting process, wherein the radiation absorbing dye is visually transmissive after welding, as recited by the method of claim 10.

e. Andrus fails to compensate for the deficiencies of Corrsin and the asserted motivation to combine their unrelated teachings is improper.

In the Office Action, the Examiner concedes that Corrsin does not disclose "an organic type of dye." However, the Examiner alleges that Andrus discloses an "organic dye (ink)" and

contends that it would have been obvious to "one of ordinary skill in the art at the time of the invention to use an organic dye (ink) as taught by Andrus et al. in the Corrsin system because it is merely a variant of ink (dye) types." *See* Office Action at page 4.

Applicant respectfully disagrees. As discussed in the Declaration, Andrus (U.S. Patent No. 5,093,147), relates to the use of an organic dye that *fluoresces* when exposed to laser radiation. However, such a fluorescing organic dye would not suggest any application to welding of workpieces in the manner claimed, since nearly no absorbed light is converted to heat as most of it is *re-emitted as fluoresced light* (light emitted at a higher wavelength than at which it was absorbed). Consequently, modification of the welding processes of Corrsin would not been obvious in view of Andrus' teaching of a fluorescing dye, and the Examiner's contention of obviousness is improperly based on a misconception regarding the very nature of Andrus teaching itself. *See* Decl. at pages 3 and 24-26.

At least for the foregoing reasons, Applicant submits that the features of method claim 10 would not have been rendered *prima facie* obvious in view of either Corrsin or Andrus, whether taken alone or in combination. Reconsideration and withdrawal of the rejection of claim 10 is respectfully requested.

With respect to claims 2-8, 13-21, 26, 27, 29, 30, and 62-75 Applicant respectfully submits that these claims are allowable at least by virtue of their dependency from claim 10, as well as by virtue of the features recited therein.

Applicant respectfully requests the reconsideration and withdrawal of this § 103 rejection.

Response to rejection of Claims 2-8, 10, 13-21, 27, 29, 62, and 67-75 under 35 U.S.C. § 103 based on Muellich in view of Andrus

Applicant respectfully traverses this ground of rejection and submits that the combination of features recited by these claims would not have been rendered *prima facie* obvious from Muellich and Andrus, whether taken alone or in combination.

In the grounds of rejection, the Examiner initially contends as follows:

> Muellich discloses the welding of thermoplastic materials using a laser beam. The transmission coefficient is used in the formation of a bond. ***Workpieces may be opaque, colored with a dye or transparent. After welding, the individual workpiece parts are substantially no longer distinguishable by the human eye.*** The proportions of the workpiece parts are joined in the visible region and dye pigment may be used for joining. Wavelengths of 1.06 um may be used. (abstract, figures, col. 3, lines 5-10, col. 7, lines 40-65, col. 8, lines 34-67).
>
> Muellich discloses a dye but not an organic type of dye.
>
> Andrus et al. discloses an organic dye (ink), which is highly absorptive of radiation in the near infrared radiation range of 750 to 900 nm. (abstract, col. 2, lines 62-68).
>
> It would have been obvious to one of ordinary skill in the art at the time of invention to use an organic dye (ink) as taught by

> Andrus et al. in the Muellich system because it is merely a variant of ink (dye) types.

See Office Action at page 4 (emphasis added).

Applicant respectfully disagrees with the Examiner's characterization of Muellich and the allegation that it would have been obvious to combine Muellich and Andrus in the manner asserted.

For instance, Muellich teaches the use of laser welding to join workpieces together to produce a resultant structure that provides a "homogenous visual impression, in particular with regard to color." *See* Muellich at col. 2, lines 18-21. However, the laser welding taught by Muellich involves providing suitable additives to both "workpiece parts" to be welded such that: a) with respect to ***infrared radiation***, one of the workpieces is substantially transparent while the other is substantially absorbent, as described at col. 2, line 64 - col. 3, line 3, and b) with respect to the visible wavelength range, the additives are ***impermeable to light rays*** so that the resulting structure provides a substantially homogeneous visual impression by virtue of the workpieces being *opaque* to visible light, as described at col. 3, lines 3-7 and col. 9, lines 19-21.

Moreover, as discussed in the 132 Declaration, Muellich teaches that black dye pigments, which are <u>not visually transmissive</u>, are used as a radiation absorber between two workpieces. *See* Decl. at pages 21-22 and Muellich at col. 7, lines 42-44. Indeed, in the welding method of Muellich, two <u>visually opaque parts</u> are joined by laser transmission welding, in which one of the parts contains a laser absorbing "black dye pigment" and the second part contains a "dye pigment" that is laser transmissive. *See* Decl. at page 2.

To further explain the type of welding taught by Muellich, an example is shown in Fig. 8 of the 132 Declaration. *See* Decl. at pages 21-23. As explained therein, both welded pieces *visually* appear black, or opaque, but actually contain different colorants from the standpoint of *infrared radiation*, one being transmissive to the laser radiation, while the other piece is absorbing to the laser. *See* Decl. at page 23. Thus, in the method of Muellich, the inorganic particulate *carbon* is used as the radiation absorber in the laser absorbing part, while colorants are added to the other part to provide the "homogeneous visual impression". *See* Decl. at pages 23-24.

However, the differences between Muellich's method and welding consistent with the method of claim 10 are readily apparent from the comparison provided in Fig. 9 of the 132 Declaration. *See* Decl. at page 24. Indeed, the claimed method allows for welding to be performed without any need to alter the color of the parts, which stands in stark contrast to Muellich's requirement of a *visually opaque appearance*, as evident from the black color shown in the upper sample of Fig. 9. *See* Decl. at page 24.

In contrast, claim 10 recites providing a *radiation absorbing organic dye* which has an absorption band in the range 780 nm – 1500 nm matched to the wavelength of the incident radiation so as to absorb the incident radiation and generate heat for the melting process, wherein the radiation absorbing organic dye is *visually transmissive after welding*. Thus, Muellich not only fails to suggest a radiation absorbing organic dye, as claimed, but Muellich's teaching of the use of a "black dye pigments" in which the welded structure includes additives that are

"impermeable to light rays" would teach one of ordinary skill in that art away from the invention, as defined by claim 10.

Furthermore, as discussed above with respect to Corrsin in view of Andrus, the Andrus patent relates to the use of an organic dye that *fluoresces* when exposed to laser radiation. However, such a fluorescing organic dye would not suggest any application to welding of workpieces in the manner defined by claim 10, since the teaching of Andrus would suggest that nearly no absorbed light is converted to heat as most of it is *re-emitted as fluoresced light* (light emitted at a higher wavelength than at which it was absorbed). Consequently, modification of the welding processes of Muellich, as with Corrsin, would not been obvious in view of Andrus' teaching of a fluorescing dye, as the Examiner improperly alleges. *See* Decl. at pages 3 and 24-26.

Thus, neither Muellich nor Andrus, whether taken alone or in combination, would teach or suggest all the features of claim 10 and the rejection is improper because it would not have been obvious to combine their teachings in the manner suggested by the Examiner. Reconsideration and withdrawal of the rejection is therefore requested.

With respect to Claim 75, Applicant further submits that, in addition to being allowable by virtue of depending from claim 10, the feature of a radiation absorbing dye that is soluble in an organic polymer, as claimed, would not have been taught or suggested by the applied art.

As discussed in the Declaration, the Andrus patent (U.S. Patent No. 5,093,147), which has been cited in combination with Corrsin and Muellich in separate rejections in the present

application relates to the use of an organic that *fluoresces* when exposed to laser radiation. However, such a fluorescing organic dye would not suggest any application to welding of workpieces in the manner claimed, nor would any modification of the welding processes of either Corrsin or Muellich been obvious in view of Andrus' teaching of a fluorescing dye. *See* Decl. at pages 3 and 24-26.

Moreover, the carbon, gypsum or polybutadiene, which are taught by Corrsin as radiation absorbers, are insoluble and would therefore not provide any suggestion for an organic radiation absorbing organic dye, as recited by claim 35. *See* Decl. at pages 6-7. Indeed, as subsequently discussed in further detail in the Declaration, Corrsin suggests the use of inorganic pigments, which would not dissolve in a substrate, but would rather remain suspended in the substrate as macroscopic agglomerates of composite molecules or ions. *See* Decl. at page 14. A pigment, such as the carbon or the gypsum taught by Corrsin, would not be soluble in organic polymers of interest. *See* Decl. at page 15.

For similar reasons, the carbon pigment of Muellich is not *soluble* in an organic polymer, as recited by claim 75.

Applicant further submits that claims 2-8, 13-21, 26, 27, 29, 30 and 62-74 are allowable at least by virtue of depending from claim 10 as well as by virtue of the features recited therein.

Applicant respectfully requests the reconsideration and withdrawal of this § 103 rejection.

Response to rejection of Claims to 63-67 under 35 U.S.C. § 103 based on Corrsin and Andrus in view of Osborne

Applicant submits that claims 63-67 are allowable at least by virtue of depending from claim 10, as well as by virtue of the respective features recited therein. Applicant respectfully requests the reconsideration and withdrawal of this § 103 rejection.

Response to rejection of Claims 26, 30, and 63-66 under 35 U.S.C. § 103 based on Muellich and Andrus in view of Osborne

Applicant submits that claims 26, 30, and 63-66 are allowable at least by virtue of depending from claim 10, as well as by virtue of the respective features recited therein. Applicant respectfully requests the reconsideration and withdrawal of this § 103 rejection.

Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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